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SUMMARY

Four years of girdling trials were carried out on Douglas-fir (*Pseudotsuga menziesii*) trees of grafted and seedling origin. Different girdling methods were applied, including complete removal of a band of bark and phloem, opposing partial bands, pruning-saw cuts, aluminum girdling inserts and a single knife-cut. Data were collected on seed and pollen cone production, tree vigour, girdle wound health and seed characteristics, for up to 4 years following girdling.

All treatments appear to be equally effective in promoting male and female flowering over ungirdled trees, and there were no differences among treatments in cone abortion, filled-seed percentages, or seed germination. However, treatments differed in their effects on tree vigour, seed weight and the speed with which the girdles healed. A simple knife-cut into the xylem seems to result in the least vigour loss and fastest healing, and is as effective as other treatments at increasing seed production. Recommendations are made for girdling procedures.

INTRODUCTION

Stem girdling is an effective treatment for enhancing flower production and subsequent seed yields in Douglas-fir (*Pseudotsuga menziesii*) and other conifers (Ebell 1971; Puritch 1977). Of the various cone enhancing treatments, it is among the consistently most effective on sexually mature trees. As well, it has the additional advantage of being convenient and economical to apply on an operational scale (Ross and Bower 1988). However, a major concern with stem girdling is the risk of adversely affecting tree health and vigour because of the wound which may take several years to heal.

In seed orchards, where high seed production over a number of years is a goal, the impact of stem girdling on tree health is of greater concern than in breeding arboreta, where 1 year with flower production may be sufficient to complete the breeding for a tree. However, in both situations it is desirable to promote flowering successfully without adversely affecting the tree's subsequent ability to mature the induced cone crop. This requires a properly timed treatment (Ebell 1971) which induces the differentiation of reproductive buds, but allows fast recovery and minimizes the effect on tree vigour.

Although girdling has received substantial attention, the effects of different methods of girdling on flowering and seed characteristics, as well as on tree health, have not been thoroughly investigated. Ebell (1971) used overlapping, half-circumference-band girdles in which 25 mm wide strips of bark and phloem were removed from opposing sides of the stem. Karlsson (1983) reported partial overlapping and complete band girdles (6 mm wide), and found the latter to be more effective in promoting flowering. However, Karlsson's two treatments were applied in different years, possibly confounding treatments with the differential production success expected in different years. Wheeler *et al.* (1985) compared partial-overlapping-band girdles to similar girdles applied with a pruning saw. They found both methods increased cone production, but the saw-cut girdles healed faster.

The series of experiments reported here used grafted ramets and seedlings of Douglas-fir to examine the effects of different girdling methods on seed and pollen cone production, seed production, seed characteristics, tree vigour and ability to recover.

MATERIALS AND METHODS

This project, carried out over a 6 year period, was divided into three experiments by treatment years. All treatments were performed on trees located at the Cowichan Lake Research Station on south-central Vancouver Island, British Columbia.

1981 and 1982 Experiment

In early May of 1981 and 1982, about 1 week before vegetative bud flush, grafted ramets were girdled with the removal of a complete 6-9 mm wide complete band of bark, phloem, and cambium, which exposed the xylem. This girdling, done initially to induce flower production for breeding, subsequently provided baseline information for this study. A different set of ramets was treated in each of the 2 years.

Ramets ranged in age from 15 to 23 years from propagation, and were arranged in clonal rows. Each girdled ramet was paired with a control (not-girdled) ramet from the same clone which was similar for size, crown exposure, and vigour. Ramets with visibly incompatible graft unions (Karlsson 1970; Copes 1974) were excluded.

1983 Experiment

This study was designed to test the effects of five different girdling methods, versus a control, on male and female flowering, seed characteristics, tree vigour and girdle wound condition. The study material consisted of six grafted ramets from each of 10 clones, ranging in age from 9 to 19 years, and six seedlings from each of five groups, ranging in age from 13 to 22 years. Ramets were arranged in clonal rows, and seedlings in family or provenance groups. All ramets within a clone and seedlings within a group were the same age. Within each clone or seedling group, the six trees chosen were of similar size, vigour and crown exposure. Ramets with incompatible graft unions were not used.

Treatments were randomly assigned to the ramets or seedlings in each group. The treatments included:

1. girdling inserts, removed in July;
2. girdling inserts, removed in June;
3. complete 6-7 mm wide band girdles;
4. 2 - 270° overlapping 6-7 mm wide band girdles;
5. complete saw-cut girdle (4-5 mm wide); and
6. control (no treatment).

Girdles were made above at least one whorl of live branches from 1 to 2 weeks before vegetative bud flush. One ramet per clone or one seedling per group was used for each treatment.

Girdling inserts were pieces of 0.6-mm sheet aluminum inserted into a single circumferential cut made with a knife. Sufficient inserts were used to form a continuous band around the tree and block translocation through the phloem. Saw-cut girdles were made with a pruning saw, and are similar to those reported by Wheeler *et al.* (1985), except these consisted of one complete band around the tree. The band-girdle treatment is similar to that used in the 1981/82 experiment, except the width was reduced to 6-7 mm.

1984 Experiment

The 1984 study was similar to that of 1983, except one of the girdling insert treatments (treatment 2) was replaced with a complete circumferential girdle made with a single cut of a sharp knife (treatment 7).

Data Collection

Table 1 outlines the types of data that were collected for the three experiments. Seed cones were counted from the ground. Pollen cone production was rated from 1 (none) to 4 (heavy). Overall tree vigour was rated subjectively on the basis of foliage colour, shoot length and needle retention, from 1 (healthy) to 6 (dead).

TABLE 1. Types of data and date collected for the three girdling experiments

Type of data	Date collected (month/year)	Experiment		
		1981/82	1983	1984
Number of cones	8/83	x		
Vigour rating	8/83	x		
Seed weight	9/83	x		
Filled seeds per cone	9/83	x		
Germination	9/83	x		
Seed cones	5/84	x	x	
Pollen cones	5/84	x	x	
Vigour rating	5/84	x	x	
Seed cones	5/85	x	x	x
Pollen cones	5/85	x	x	x
Vigour rating	5/85	x	x	x
Vigour rating	9/85		x	x
Seed cone abortion	9/85		x	x
Girdle health rating	10/85		x	x
Percent of girdle healed	10/85		x	x
Dioryctria damage rating	10/85		x	x
1984 leader length %	10/85		x	x
1985 leader length %	10/85		x	x
Seed weight	9/85		x	x
Filled seeds per cone	9/85		x	x
Germination	9/85		x	x
Seed cones	5/86		x	x
Pollen cones	5/86		x	x
Vigour rating	5/86		x	x

In the fall of 1983 and 1985 cones were picked from all producing trees. Seeds were extracted and cleaned, and X-rays used to remove empty seeds. Average filled seeds per cone and seed weight were calculated for each tree. Filled seeds were stratified and germinated following the method of the ISTA (1985).

Cone abortion was assessed in August, and rated from 1 (none) to 3 (heavy). Girdle health was rated from 1 (good) to 5 (poor), based on the amount of callousing, pitch, insect damage, and smooth new tissue covering the wound. To measure girdle healing, the percentage of the girdle circumference that was healed (as indicated by smooth healthy tissue covering the wound) was determined. *Dioryctria* (*Dioryctria pseudotsugella*) infestation of girdles was rated from 1 (none) to 4 (apparent damage over most of the girdle). Leader length from the 1984 and 1985 growing seasons was assessed as a percentage of the leader length of the untreated tree in each group.

Data Analysis

Data from this study fall into four analysis categories:

1. quantitative variables, including seed cone number, filled seeds per cone and seed weight;
2. proportions, including 1984 and 1985 leader length as a percent of the control, and the percent of the girdle circumference which is healed;

3. qualitative variables, including vigour, pollen cones, cone abortion, girdle health and *Dioryctria* ratings; and

4. germination data.

Quantitative variables, and arcsin square-root transformed proportions (p), were analyzed with ANOVA. Class variables were summarized and checked for trends. Germination data were plotted to show percent germination by day, and total percent germination was calculated. Germination amount and rate were very similar for all the seedlots, and further analysis was considered unnecessary.

RESULTS

Seed Cone Production

Seed cone production is summarized in Table 2. In general, girdling treatments increased seed cone production the following year, with production dropping closer to the level of control trees 2 years after girdling. Flower production in 1984 was very poor, with girdled trees producing little more than controls.

In the 1984 experiment, seed cone production 1 year after treatment was greater for girdled than non-girdled trees (P=0.007) (Table 3). However, there was little difference between individual girdling treatments. Very little seed cone abortion was observed on any of the girdled trees in any year.

Excluding the 1983 experiment, in which the treatment year was followed by a very poor cone production year, girdling increased seed cone production by 472% 1 year after treatment, and 170% 2 years after treatment relative to controls. Seed cone production success 2 years after treatment was inversely related to success 1 year after treatment.

TABLE 2. Average seed cone production (± standard error) by the number of years following girdle treatment, and by treatment type

Experiment and treatment	Years following treatment			
	1	2	3	4
1981/82 Experiment				
1981 girdling				
Complete band girdle	-	348(121)a	Oa	94(73)a
Control	-	113(76) b	Oa	O a
1982 girdling				
Complete band girdle	369(51)a	3(3)a	40(20)a	-
Control	54(29) b	O a	O a	-
1983 Experiment				
Inserts (out July)	27(25)a	248(103)a	59(29)a	-
Inserts (out June)	14(9) a	269(96) a	88(48)a	-
Complete band girdle	8(6) a	190(70) a	71(26)a	-
Overlapping partial bands	4(4) a	186(55) a	24(9) a	-
Saw-cut	5(5) a	133(62) a	61(29)a	-
Control	1(1) a	187(89) a	89(33)a	-
1984 Experiment				
Complete band girdle	269(88)a	75(28)a	-	-
Knife-cut	213(79)ab	56(27)a	-	-
Girdling inserts (out July)	206(53)ab	25(11)a	-	-
Saw-cut	204(62)ab	52(17)a	-	-
Overlapping partial bands	185(58)ab	87(25)a	-	-
Control	82(67) b	65(27)a	-	-
Average for girdled as a percent of control*	472%	170%	68%	-

Note: Values within experiments followed by different letters are significantly different (P<0.05) based on Duncan's multiple range test.

* 1983 experiment excluded from the first year's average because of very low cone production; third year average includes the 1983 experiment only.

TABLE 3. Summary of analysis of variance for seed cone production by treatment year and the number of years following treatment

Source	Years following treatment[a]								
		1		2		3		4	
	DF	SS%	P	SS%	P	SS%	P	SS%	P
1981/82 Experiment									
1981 girdling									
Treatment	1	-	-	16	0.019	-	-	10	0.24
Clone	7	-	-	72	0.016	-	-	45	0.50
1982 girdling									
Treatment	1	22	0.0001	-	-	4	0.0531	-	-
Clone	50	54	0.0019	-	-	48	0.5000	-	-
1983 Experiment									
Treatment	5	4	0.4124	2	0.6554	3	0.6804	-	-
contrast: control vs. girdled	1	1	0.3005	0	0.7800	1	0.3999	-	-
Tree type[b]	1	0	0.6648	0	0.5018	0	0.9763	-	-
ID[c]	13	39	0.0002	53	0.0001	21	0.1564	-	-
1984 Experiment									
Treatment	5	5	0.0952	5	0.4934	-	-	-	-
contrast: control vs. girdled	1	4	0.0071	0	0.8260	-	-	-	-
Tree type[b]	1	4	0.0030	4	0.0719	-	-	-	-
ID[c]	12	58	0.0001	14	0.3846	-	-	-	-

[a] SS% = percent of total sum of squares explained by the listed effect. P values are probabilities associated with the null hypothesis, Ho: no difference exists between groups within the listed effect.

[b] Seedling or grafted tree.

[c] Clone, family, or provenance group.

Pollen Cone Production

Table 4 shows 1985 pollen cone production class by treatment for trees girdled in the 1984 experiment. Pollen cone production appears to increase the year following girdling, but little effect is evident beyond 1 year. As with seed cone production, girdling had little impact on pollen production in the poor crop year of 1984. Girdled trees tend to polarize to having no pollen crop or a heavy crop, with few trees being rated in between. Based on the single year of data presented in Table 4, girdling increased the number of trees rated medium or heavy for pollen production from an average of 13% for controls to 43% for girdled trees.

TABLE 4. Percentage of girdled and non-girdled trees with medium or heavy pollen crops, by experiment and years following treatment

Experiment	Treatment	Pollen production % by years following treatment		
		1	2	3
1981/82	girdled	-	2%	-
	non-girdled	-	0%	-
1983	girdled	4%	27%	23%
	non-girdled	0%	33%	13%
1984	girdled	43%	9%	-
	non-girdled	13%	7%	-

Seed Production

Average filled seeds per cone (FSPC) and seed weight were assessed in 1983 collections for trees girdled in 1981 and 1982, and in 1985 collections for trees girdled in 1983 and 1984. There were no significant treatment effects ($P>0.10$) on FSPC, but the complete-band girdle consistently ranked behind the other treatments. Significant seedling group or clone effects ($P<0.05$) were noted. No differences in FSPC were found between grafts and trees grown from seed.

Seed weight was reduced by treatment the first year after girdling, but differences were negligible the second year. In the 1984 experiment, all treatments except the knife-cut significantly ($P<0.05$) reduced seed weight in seed collected in 1985 (Table 5). Seed weight also varied among clone and seedling groups, but no differences were seen between clonal and seedling material.

TABLE 5. Average seed weight by treatment type for seed collected in 1985 from trees girdled in 1983 and 1984

Treatment	Seed weight (g)[a]
Control	0.0138 a
Knife-cut	0.0127 ab
Overlapping bands	0.0125 b
Saw-cut	0.0117 bc
Inserts (out June)	0.0110 cd
Inserts (out July)	0.0102 d
Complete band	0.0102 d

[a] Values followed by different letters are significantly different ($P<0.05$) based on Duncan's multiple range test.

Seed Germination

Germination rate and final percentage were similar for seedlots from both control and girdled trees. Seed collected in 1983 from trees in the 1981/82 experiment had over 94% germination for 19 of the 20 trees tested. One girdled tree produced seed germinating at 74%, compared to 99% for the control tree from the same clone. Rate of germination was also similar for the different treatments, with all lots achieving over 90% of their total germination by day 12.

Seed collected in 1985 from trees treated in the 1983 and 1984 experiments had similarly high germination: 92-100% for non-girdled trees and 88-100% for girdled trees, with the exception of one tree that averaged 72%. Rate of germination was again very similar, with all seedlots achieving over 90% of their total germination by day 13.

No differences were detected in germination rate or final percentage between seed collected 1 year versus 2 years after treatment.

Tree Vigour

Tree vigour class assessments are summarized in Table 6. All treatments resulted in fewer trees being rated as healthy, relative to control trees, but all trees generally recovered within 2 years of treatment. Comparisons among years may be slightly biased because of inconsistent rating. The less damaging treatments, such as the single knife-cut, maintained higher vigour compared to the complete-band girdle. Results are somewhat confounded by graft union compatibility, which was the only apparent reason for declining vigour in control trees.

Leader growth was consistently reduced ($P<0.001$) for up to 2 years following girdling. Results from the 1983 experiment (not shown) are similar to the 1984 experiment (Table 7) except the saw-cut girdle ranks poorest in the 1983 experiment and best in the 1984 experiment. Overall, the complete-band girdle caused the greatest decrease in height growth.

TABLE 6. Percentage of trees by vigour class and year following treatment for each of the study years (1981 and 1982 treatment data combined)

Treatment	Vigour class[a] by years following girdling																		n
	1 year						2 years						3 years						
	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	
1981/82 Experiment																			
Complete band	29	25	24	18	4	0	11	27	42	10	5	5	46	30	10	2	2	10	59
Control	94	6	0	0	0	0	86	9	5	0	0	0	85	10	5	0	0	0	59
1983 Experiment																			
Inserts (out July)	0	20	80	0	0	0	67	20	0	0	0	13	67	13	0	0	0	20	15
Inserts (out June)	0	7	93	0	0	0	53	33	7	0	0	7	60	27	0	0	7	7	15
Complete band	0	7	80	13	0	0	33	27	20	7	0	13	47	20	13	7	0	13	15
Overlapping bands	0	7	87	0	7	0	40	27	7	0	13	13	47	20	7	0	0	27	15
Saw-cut	0	7	80	13	0	0	47	27	13	0	7	7	33	40	0	13	0	13	15
Control	87	7	7	0	0	0	87	7	0	0	0	7	87	0	0	0	0	13	15
1984 Experiment																			
Inserts (out July)	33	33	20	13	0	0	60	0	0	7	13	20	-	-	-	-	-	-	15
Complete band	13	40	33	7	7	0	27	0	7	33	7	27	-	-	-	-	-	-	15
Saw-cut	67	20	13	0	0	0	73	0	0	7	0	20	-	-	-	-	-	-	15
Overlapping bands	40	40	13	7	0	0	73	7	13	7	0	0	-	-	-	-	-	-	15
Knife-cut	73	13	7	7	0	0	93	0	0	0	7	0	-	-	-	-	-	-	15
Control	93	7	0	0	0	0	87	0	13	0	0	0	-	-	-	-	-	-	15

[a] Vigour class: 1 = very healthy to 6 = dead.

TABLE 7. Average leader length one and two growing seasons following girdling, expressed as a percentage of the control trees, (1984 experiment)

Treatment	Years following treatment[a]	
	1	2
Control	100 a	100 a
Saw-cut	88 b	88 abc
Knife-cut	85 bc	90 ab
Overlapping bands	82 bc	78 bc
Inserts (out July)	81 bc	74 c
Complete band	78 c	75 c

[a] Values followed by different letters are significantly different ($P<0.05$) based on Duncan's multiple range test using arcsin transformed values.

During this study, 2 control trees (2.2%) died from graft incompatibility. As well, 25 girdled trees (12%) died from the following causes: rootrot (2 trees), wind breakage at the girdle (1 tree), apparent re-girdling by *Dioryctria* (6 trees), failure to heal (1 tree) and unknown (14 trees). Within the unknown class, some trees appeared to have died from incompatibility. However, the degree to which the additional stress from girdling may have interacted with incompatibility could not be assessed. These mortality figures are for all types of girdle treatments. The less damaging treatments, such as the knife-cut, resulted in a lower rate of mortality.

Girdle Healing

For the 1983 and 1984 experiments, three types of data (Table 8) were collected to assess girdle condition:

1. a rating of girdle health;
2. the percent of the girdle healed as indicated by smooth new tissue over the wound; and
3. a rating of damage due to *Dioryctria*.

TABLE 8. Girdle condition and *Dioryctria* damage ratings expressed as a percentage by class, and average percentage of girdle circumference healed, for 1983 and 1984 treatments. All assessments done in September 1985. Girdle health: 1 (good) to 5 (poor); *Dioryctria* damage: 1 (none) to 4 (heavy)

Treatment	Girdle health					*Dioryctria*				Percent healed[a]	n
	1	2	3	4	5	1	2	3	4		
1983 Experiment											
Inserts (out July)	33	42	25	0	0	67	25	8	0	90 a	12
Inserts (out June)	50	36	7	7	0	50	36	14	0	86 a	14
Complete band	8	31	38	23	0	38	46	8	8	70 b	13
Overlapping bands	9	27	45	18	0	36	36	18	9	66 b	11
Saw-cut	8	23	38	15	15	31	15	31	23	57 b	13
1984 Experiment											
Complete band	18	28	18	18	18	27	27	19	27	65 a	11
Inserts (out July)	31	23	23	23	0	46	23	23	8	75 ab	13
Overlapping bands	13	54	20	13	0	47	40	0	13	77 ab	13
Saw-cut	31	31	31	7	0	54	15	23	8	81 ab	15
Knife-cut	53	27	20	0	0	60	20	13	7	91 b	15

[a] Values within each experiment followed by different letters are significantly different ($P<0.05$) based on Duncan's multiple range test.

Ratings of girdle health show some inconsistencies between the 1983 and 1984 treatment years. Although the 1983 saw-cut treatment was worst for overall healing ability, in 1984 this treatment was one of the best. This inconsistency was also evident for the *Dioryctria* damage rating and the average percent of the girdle which was healed.

In general, the overlapping girdle and the complete-band girdle were the slowest to heal and had the most *Dioryctria* damage. Both of these treatments removed a 6-7 mm wide strip of bark. The girdle-insert treatments generally healed better than band treatments, with earlier removal of the insert resulting in better healing. The knife-cut treatment appeared to result in the fastest girdle recovery and allowed the least insect damage.

DISCUSSION

Experience with stem girdling indicates it is an effective and easily applied treatment to enhance flower production on Douglas-fir grafts and seedlings. It is, however, a stress treatment and repeated application may retard vegetative growth and the ability to recover flowering potential (Ross and Pharis 1986). Treatments that supply the minimum required stress and allow earlier and faster recovery are the most desirable.

Results from this study suggest the range of girdling treatments used were all equally effective at supplying the stress needed to initiate seed and pollen cones. Cone abortion and filled seed percentage were not significantly different from non-girdled trees; nor were there differences between individual girdling treatments.

Seed weight was depressed by girdling, but the differences noted were small, and there was no indication that this affected seed germination rate or capacity. The ability of girdling treatments to increase seed and pollen production appears to depend partially on the level of natural cone crop developing. Experience before and during this study indicates that girdling is successful most years. However, on very poor crop years (such as 1984) girdling treatment may have little effect, as was also noted by Wheeler *et al.* (1985).

On average, girdling treatments greatly increased seed and pollen cone production (Tables 2 and 4). However, the study trees were located in an area with higher mean annual rainfall (more suitable for good vegetative growth than for consistent seed production) than occurs on the drier climatic areas where seed orchards are generally located. As a result, the increases in both the number of cones and the proportion of trees producing relative to non-girdled trees, may be greater than what would be expected in a drier climate.

All of the girdling treatments consistently reduced tree vigour. However, the amount of vigour reduction and the rate of recovery varied among treatments. The treatments that caused the greatest tissue disturbance, such as the band girdles, resulted in the greatest vigour loss. The girdling inserts blocked translocation through the phloem, but they also blocked healing until they were removed. Therefore, even though there was little tissue disturbance, the vigour of trees girdled in this manner was reduced compared to those girdled with a simple knife-cut around the tree. Girdles performed with a pruning saw generally had less effect on tree vigour than did band girdles. Compared to girdle inserts, however, the results are somewhat variable and differences are not strongly evident. The knife-cut treatment appeared to have the least impact on tree vigour and showed a faster return to normal than did the other treatments.

Little cone abortion was observed in this study, indicating vigour losses were insufficient to affect the cone crop severely. This is in agreement with Wheeler *et al.* (1985) who did not clearly identify cone abortion with girdling.

Subjective evaluations of girdle condition generally agreed with tree vigour ratings. As would be expected, treatments which resulted in the healthiest and most quickly healing girdle wounds also resulted in the least vigour reduction. However, differences between treatments were more evident with the evaluation of girdle health. In general, the knife-cut girdles were the healthiest and healed faster than did the other treatments.

Dioryctria damage in the girdle wound slows healing, and can stress or even kill the tree. Treatment with an insecticide is feasible, and is recommended by Wheeler *et al.* (1985). Another method, which may be equally effective and more desirable, is to wrap the wound with several layers of soft cloth. *Dioryctria* oviposit during the period from late May to August (D. Ruth, Canadian Forestry Service, pers. comm.), and the cloth may prevent the adult moth from laying eggs in the wound. This method has not been extensively tested.

The complete-circumference knife-cut girdle was as effective as other girdling methods at increasing seed and pollen production, and had less impact on tree vigour and ability to heal. If the knife-cut method is to be used in areas with a climate more suitable for seed production than the area in which this study was conducted, less severe treatments, such as 180° opposing cuts separated by about 10 cm, or a single cut around 90-98% of the circumference, may be sufficient. Some experimentation in local areas is suggested.

RECOMMENDATIONS

Based on the results from this and other studies, and experience beyond these data, the following recommendations are made for girdling to increase seed production:

1. Girdle from 1 to 3 weeks before vegetative bud flush.
2. Perform a single cut into the xylem (hard wood) with a sharp knife.
3. Proceed cautiously in local areas, with incomplete (90-98%) girdles at first, and complete bands if experience indicates this is necessary.
4. Girdle above at least one whorl of live branches. This will not usually affect cone production, and will aid tree vigour by leaving some crown to supply photosynthates to the roots.
5. Treat the girdle wounds with an insecticide at the time of girdling, or wrap the wound with several layers of breathable cloth.
6. Fertilize girdled trees at the time of treatment with ammonium nitrate (Ebell and McMullan 1970) at the rate of about 300-400 kg N/ha. (Base on local experience.)
7. Girdle trees every second year or less. Annual girdling may cause excessive stress on existing cone crops and on the trees' ability to produce future crops.
8. Girdling should be preceded by a survey for reproductive buds to avoid possible damage to the current year's seed crop.

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